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ABSTRACT

Today, many people, with no personal experience of living through a tropical storm, reside in coastal regions in harms way. This population needs to be educated about storm risks. One good venue for this is the public school system. Science educators have concluded it is important to establish a knowledge base about the ways students think and learn in the classroom to design appropriate and effective instructional materials. There is a need to fill the gap in hazards research about students' perceptions and preconceptions about these events. A research study determined high school students' perceptions and preconceptions about tropical storms and the damage they do to coastal communities. The study used Okhee Lee's (1999) research on Hurricane Andrew as a model and augments Lee's results. In-depth interviews, a survey, and class discussions with high school students living in Houston, Texas provided the data. Students, representing a wide variety of ethnic backgrounds, vary in their perceptions and preconceptions about tropical storms. The results show perceptions students developed after personal experiences with tropical storm Allison formed most of their general preconceptions about tropical storms. Overall, students' scientific knowledge about tropical storms is poor. (Contains 22 references and 6 tables.) (Author/BT)

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High School Students' Preconceptions and Conceptions About Tropical Storm Allison

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Abstract

Today many people with no personal experience of living through a tropical storm reside in coastal regions in harms way. There is a need to educate this population about storm risks. One good venue for this purpose is the public school system. Science educators have concluded it is important to establish a knowledge base about the various ways students think and learn in the classroom in order to design appropriate and effective instructional materials. There is also a need to fill the gap in hazards research about students' perceptions and preconceptions about these events. The purpose of this research study is to determine high school students' perceptions and preconceptions about tropical storms and the damage they do to coastal communities. This study used Lee's (1999) research study on Hurricane Andrew as a model and augments Lee's results. In-depth interviews, a survey, and class discussions with high school students living in Houston, Texas provided the data. The students, representing a wide variety of ethnic backgrounds, vary in their perceptions and preconceptions about tropical storms. The results of the data show perceptions they developed after personal experiences with Tropical Storm Allison formed most of their general preconceptions about tropical storms. Overall, students' scientific knowledge about tropical storms is poor.

Key words: perceptions, natural hazards, high school students, Tropical Storm Allison

Introduction

The purpose of this study was to discover high school students' preconceptions and conceptions about tropical storms. Since I am looking at students' thoughts and feelings before and after Tropical Storm Allison, I need to use terms that capture the time element while defining their thoughts and feelings (Table 1).

Table 1
Definitions

Preconception	Perception	*Conception*
• Before event • Before academic instruction	• During event • During academic instruction	• After event • After academic instruction

The brain processes stimuli while a person experiences an event or receives academic instruction and develops an explanation of what is happening. This process is called "perception." Before an event or academic instruction, a person has an established set of thoughts and feelings about how their world works. These thoughts and feelings are called "preconceptions." After experiencing an event or academic instruction, the perceptions a person develops from that event

or academic instruction are added to the preconceptions that person holds. These new thoughts and feelings are called "conceptions."

This study aimed to augment Okhee Lee's (1999) study about students' conceptions about hurricanes. This study was conducted in Dade County, Florida after Hurricane Andrew devastated that region. One-hundred-twenty-seven fourth and fifth grade students were interviewed about their conceptions of hurricanes. Their scientific knowledge about hurricane development was also studied. This study augmented Lee's work by interviewing a different age group and focusing on hazardous impacts of tropical storms. High School students were interviewed about their preconceptions and conceptions about tropical storms because they have received academic instruction about tropical storms and they are able to articulate their thought and feelings. Tropical storms were used as the subject matter for this study instead of hurricanes because Tropical Storm Allison struck Houston and deposited 14-36 inches of rain in five days in June 2001. I examined their understanding of tropical storms. I also looked at the role demographic facts play, if any, in their conceptions about these events.

Understanding the learning process is important to understanding research results in the educational and hazards disciplines. The learning process begins in infancy and continues throughout a person's life. It begins when the brain receives stimuli and goes through the perception process. The individual develops ways to explain these experiences, and so develops conceptions. The brain groups conceptions together, forming multiple networks. These networks are then connected to each other, which forms a foundation or conceptual framework (Bransford *et al.* 2000, 79-80; Cocking, Mestre and Brown 2000; National Research Council 1999, 24; Shore 1997, 20-23; Strauss and Quinn 1997, 51-53). Since all experiences occur within a social context, social factors such as gender, ethnicity, and socio-economic status influences a person's conceptual framework Alexander 2000, 7-11; Blaike *et* al. 1994, 3-9; Bransford *et al.* 2000, 10; Bruner 1996, 14; Cobern 1996; Hewitt 1997, 27; National Research Council 1999, 24; Tobin and MOntz 1997, 11-12). As an individual goes through life, new experiences are compared to what is already known and new knowledge as added to the existing conceptual framework (Ballantyne and Packer 1996; Beeth and Hewson 1999; Carey 2000; Cobern 1996; Driver *et al.* 1994; Georghiades 2000; Mestre 1994; Mestre, Raizen and Shavelson 1994, 3-i and 3-ii; Minstrell 1989; Vosniadou and Brewer 1992; Vosniadou *et al.* 2001). The "bottom line" for both education and hazards research is twofold. First, experience is an important factor in people's understanding of the world around them and natural hazards in particular. Second, the social context of these experiences affects people's understanding.

Study

The research questions I asked are:

1. "What are students' preconceptions and conceptions about tropical storms?"
2. "What are students' preconceptions and conceptions about the damage tropical storms do to coastal communities?"
3. "What are the factors that influence students' formulation of preconceptions and conceptions?"

The student sample consisted of ninth and tenth grade students studying World Geography at two high schools in Houston, Texas. The student population was ethnically and economically diverse. I worked with males and females from high and low socio-economic groups. Four ethnic groups were identified: African-Americans, Asian-Americans, Hispanics, and Whites. The research study was conducted in three stages. The first stage was the in-depth

interviews. The second stage was the knowledge survey. The third stage was the class discussions. Three types of evidence were collected to triangulate the data and thus reduce any inherent bias.

For the first stage, I conducted in-depth interviews outside of the classroom with 15 students at Sharpstown High School. The students were interviewed in pairs of the same gender and ethnicity to make the interviews more comfortable (Table 2). The exception to this is the White male. This was due to the fact that there was only one White male available to do the in-depth interview the day I conducted them. I asked the students a series of nine questions. Three of the questions asked about their thoughts and feelings about tropical storms before Allison. One question asked them to describe their experiences with Allison. Three of the questions asked about their thoughts and feelings after Allison. Two of the questions asked about their thoughts about the damage tropical storms do to coastal communities.

Table 2
In-depth Interviews

	African-American	Asian-American	White	Hispanic
Female	2	2	2	2
Male	2	2	1	2

For the second stage, the survey was administered to eight classes from Sharpstown and Bellaire High Schools. I administered a knowledge survey at the beginning of the students' regular class period. There was a total 186 students who participated in the survey (Table 3). The purpose of the survey was to identify the students' scientific knowledge of tropical storms and to see whether there is a relationship between their experiences and their science knowledge. The first section of the survey measured students' general scientific knowledge about tropical storms. The second section gathered demographic information that provided context and explanation for answers in the first section. The survey also served as an advanced organizer to the class discussions that followed.

Table 3
Knowledge Survey

	African-American	Asian-American	White	Hispanic
Female	20	16	18	28
Male	30	12	19	43
Total	50	28	37	71

After the surveys were handed in, I proceeded with the third stage, namely the class discussions. The purpose of the class discussions was to expand upon the responses from the in-depth interviews and to provide a context for understanding the interviewees' experiences. I asked the same questions as the in-depth interviews. The discussions were very open-ended and different numbers of students answered each question.

Findings

The first research question looked at the students' preconceptions and conceptions about tropical storms in general. The findings for this question (Table 4) are separated into two categories: 1) interviews and discussions, and 2) knowledge survey. Before Allison, the majority of the students' preconceptions about tropical storms were that they are like regular thunderstorms and that they are not dangerous. The rationale they gave was that Houston gets lots of big thunderstorms, some of which were called tropical storms. After Allison, the majority of the students' conceptions about tropical storms are that they are like super big thunderstorms that are dangerous. The shift in the students' conceptions aligns with their experiences with Allison.

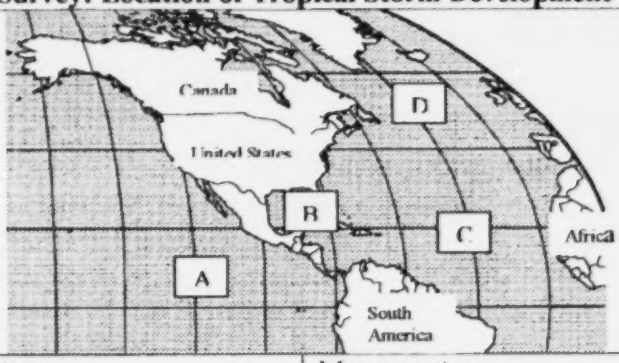
Table 4
Research Question 1 Findings

Interviews and Discussions	Preconceptions • Tropical storms are like regular thunderstorms – 58% • They are not dangerous – 54% Conceptions • Tropical storms are like super big thunderstorms – 68% • They are dangerous – 54%
Scientific Knowledge Survey	Basic shape for tropical storms is circular – 85% Factors for tropical storm development are: • Thunderstorms – 38% • Warm ocean temperatures – 52% • Strong upper level winds (incorrect) – 54% Maximum sustained winds are 39-73 mph – 56% Wind direction is counterclockwise – 54%

Based on the results of the knowledge survey (Table 4), the majority of the students' conceptions about tropical storms are correct in that the basic shape for tropical storms is circular, the maximum sustained winds are 39-74 mph, and the wind direction in the northern hemisphere is counterclockwise. However, the students' conceptions about the factors for tropical storm development proved to be interesting. While their conceptions that thunderstorms and warm ocean temperatures are factors for tropical storm development are correct, their conceptions about the upper level winds are incorrect. The students' conceptions about factors for development could come from the weather service talking about the rain, warm waters, and high winds. The high winds are not directly identified as being surface level winds and the upper level winds are not mentioned in their broadcasts.

The survey also asked the students to identify where tropical storms develop that hit the Texas coast. It was asked in two formats to see which way they have a better understanding of location (Table 5). The results indicate that the students have a better visual understanding than a verbal understanding of location. The preponderance of answers that tropical storms develop in the Gulf of Mexico could be due to the location of Allison's development. This emphasizes again that their experiences are the basis for their conceptions.

Table 5
Survey: Location of Tropical Storm Development



Written question	*Map question*
Tropical storms develop in: • Gulf of Mexico – 72% • Atlantic between Africa and Caribbean Islands – 26% • Both (correct response) – 8%	Tropical storms develop in: • Gulf of Mexico – 74% • Atlantic between Africa and Caribbean Islands – 37% • Both (correct response) – 20%

The second research question looked at the students' conceptions about the damage tropical storms can do to coastal communities. The findings for this question are also separated into the same two categories. The interviews and class discussions revealed that the students had few conceptions about the damage a tropical storm could do before Allison. Seeing the effects of Allison allowed them to form rich and detailed conceptions about the damage a tropical storm can do to a coastal community. The primary source of damage the students noted comes from flooding and they were able to provide an extensive list of damage flooding can do to a community. Their conceptions once again match their experiences with the damage Allison did to Houston.

Table 6
Survey: Tropical Storm Damage

- Flood streets and houses (correct) – 85%
- Knock out electricity (correct) – 76%
- Blow down tree branches (correct) – 68%
- Break windows – 58%
- Tear roofs off houses – 56%
- Move cars around – 39%
- Make water unsafe to drink (correct) – 29%

- Erode beaches (correct) – 37%
- Cover roads near beach with sand (correct) – 32%
- Destroy sand dunes (correct) – 19%

The survey results also correlate to the students' experiences with Allison (Table 6). The most popular responses were streets and houses being flooded, electricity being knocked out, and

tree branches being blown down. Many students associated hurricane strength winds with tropical storms as indicated by windows breaking, roofs being torn off houses, and cars being moved around. Since Houston's drinking water was not compromised in their neighborhoods, few students identified unsafe drinking water as one of the impacts of a tropical storm. In addition, few students correctly identified the impacts of a tropical storm at the beach.

The third research question looked at the possible factors that influence the students' formulation of their preconceptions and conceptions. All three types of evidence were used to elucidate these possible factors. The foremost factor is the sources students used to gather and retain scientific knowledge. The primary sources of information came from their personal experiences and watching the event on television. However, these personal experiences did not provide students with adequate scientific knowledge about tropical storms.

There were four instances where possible cultural influences were expressed. First, some of the males downplayed the danger of tropical storms. This could be an example of what may be ascribed to bravado typical of men. Second, three Asian-American females expressed a deep concern for the well being of their families and needy people. Third, some of the African-American students expressed a fatalistic attitude about tropical storms. They talked about how God is in control and the need to pray for deliverance. Fourth, the higher socio-economic status students tended to be more aware of their families' finances and were more concerned with the financial costs of Allison. One interesting finding is that, due to a lack of preconceptions or scientific knowledge, demographic factors had minimal opportunities to impact students' conceptions about tropical storms.

Conclusions

Comparing Okhee Lee's (1999) study with this study, there are two points where the two studies agree and one point where the studies disagree. First, Lee found that students have an "adequate knowledge" based on their experiences, but they failed to develop a coherent understanding beyond those experiences. This study found that students have adequate knowledge of tropical storm damage based on their experiences. However, these personal experiences did not provide adequate scientific knowledge. Second, Lee found that students developed meanings of hurricanes based on multiple information sources with television and parents being the primary sources of information. This study found that personal experiences and television were the primary sources the students used to gather and retain scientific knowledge.

Where we disagree is in the range of preconceptions and conceptions students have about these events. Lee (1999) found that the students had a broad range of preconceptions and conceptions about hurricanes. These varied by socio-economic status, gender, and ethnicity. This study found that the students had a narrow range of preconceptions and conceptions about tropical storms. This is probably due to demographic influences having minimal opportunities to impact their conceptions.

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